A Magnetization Switching Phase Diagram of a Nanostructured Magnetic Thin Film

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Precise understanding of the dynamics of magnetization switching provides a way to achieve high speed switching and low switching field. Magnetization switching under combined in-plane fields along the longitudinal (He) and the transverse direction (Ht) is well described by the asteroid curve from Stoner-Wohlfarh (SW) model [1]. In asteroid curve, switching is determined by tracing the zero energy barrier condition from energy profile. However, under dynamic condition, magnetization switching occurs even with finite value of energy barrier which is below the critical limit from SW model [2]. This sub-SW switching occurs since large portion of energy surface is explored under dynamic condition, including the path of continuously decreasing energy, and criterion for sub-SW switching is that the energy at initial point and at saddle point should be coincide [3]. However, two criterions for critical curves mentioned above, only determines switching under static condition (static critical curve (sCC)) or dynamic condition (dynamic critical curve (dCC)), and information on switching behaviors is not provided. In the mean time, recent paper reported three types of dynamic switching behavior: nonswitching, incoherent switching and coherent switching based on numerical micromagnetic simulation [4], but no further analytical interpretation was given.

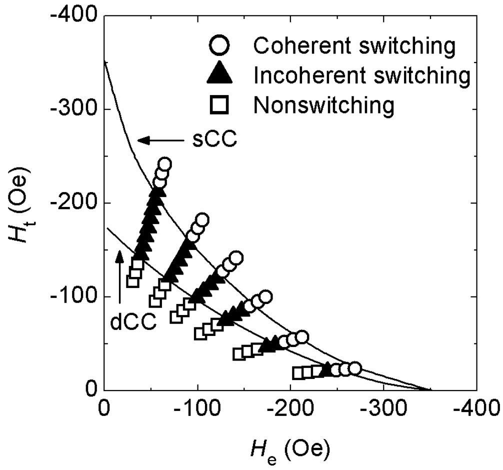

Fig. 1 The switching phase diagram calculated both numerically and analytically

In this study, analytically constructed switching phase diagram of a nanostructured magnetic thin film is proposed, which gives informations on critical curve for switching and three types of magnetization switching behaviors. The analytically calculated switching phase diagram was compared with the results obtained by numerical micromagnetic simulation.

References

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